Cover Page Plane Geometry CP

Content Area: **Mathematics**
Course(s):
Time Period:
Length: **Full Year**
Status: **Published**

Course Overview

This course begins with an introduction to basic geometric concepts and an in-depth study and classification of lines, triangles, other polygons and circles. Real world problem solving are fundamental bearings of the course. The idea of proof, including emphasis on congruence and similarity, are stressed. In addition, students will explore concepts related to three dimensional figures. Students will complete more extensive units on the surface area and volume of prisms, cylinders, pyramids and cones. They will study the concepts of congruence and similarity of solids and will examine equations relating to statistics and geometric models of motion.

In order to demonstrate a cohesive and complete implementation plan the following general suggestions are provided:

- The use of various formative assessments are encouraged in order to provide an ongoing method of determining the current level of understanding the students have of the material presented.
- Homework, when assigned should be relevant and reflective of the current teaching taking place in the classroom.
- Organizational strategies should be in place that allow the students the ability to take the information gained in the classroom and put in in terms that are relevant to them.
- Instruction should be differentiated to allow students the best opportunity to learn.
- Assessments should be varied and assess topics of instruction delivered in class.
- Modifications to the curriculum should be included that address students with Individualized Educational Plans (IEP), English Language Learners (ELL), and those requiring other modifications (504 plans).

Course Name, Length, Date of Revision and Curriculum Writer

Geometry Honors

Full Year

Date: 05/31/2024

Curriculum Writer: Christine Boyd

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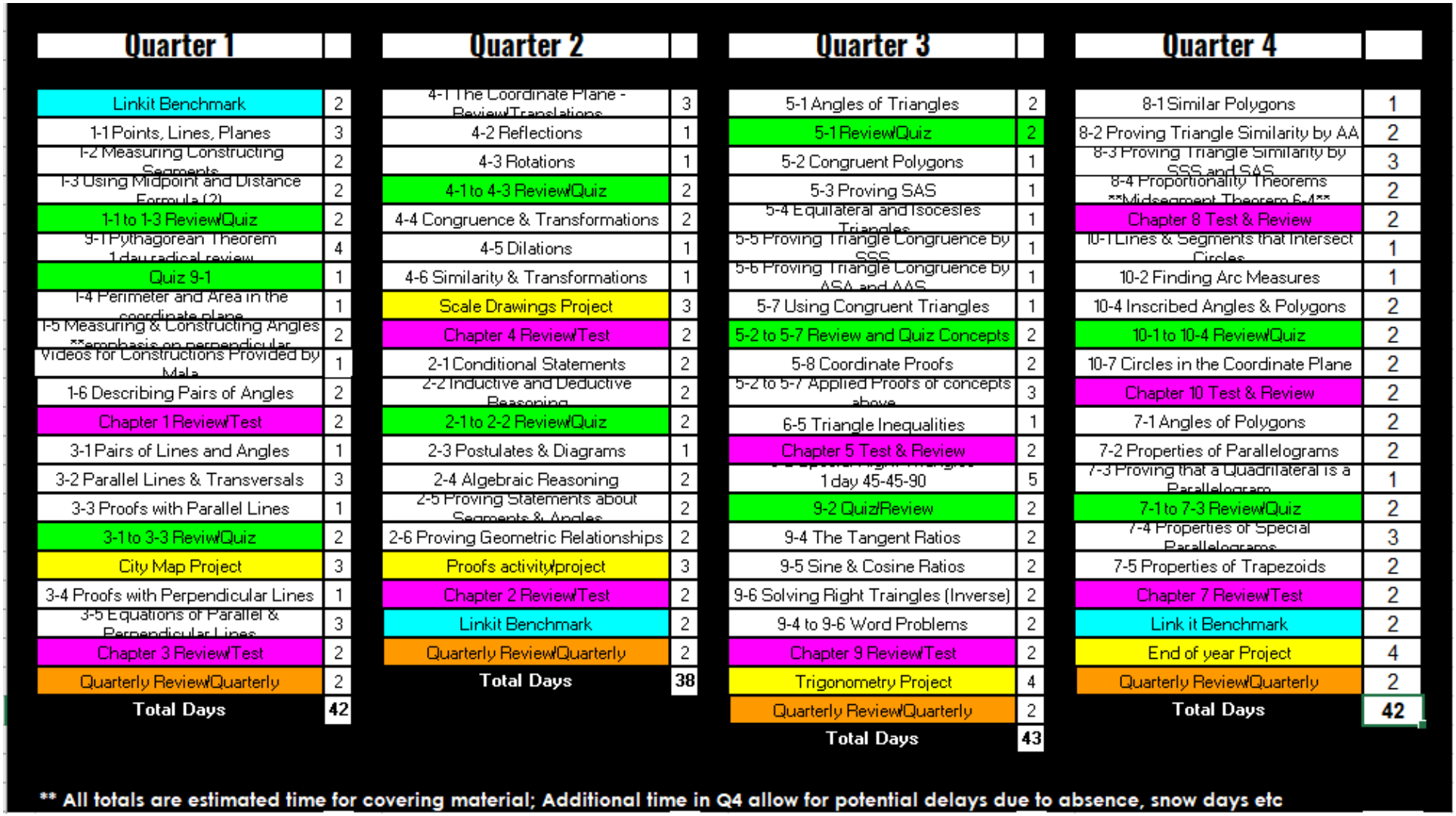
Unit 4: Trigonometric Ratios, Circles, and Volume.

Scope and Sequence



Basics of Geometry, Reasoning and Proofs. Parallel and Perpendicular Lines.

Content Area: **Mathematics**
Course(s):

Time Period: **1st Marking Period**
Length: **42 days**
Status: **Published**

Summary of the Unit

In this Unit, students will name and sketch geometric figures, use postulates to identify congruent segments, find the lengths of segments in the coordinate plane, and find the midpoint of a segment. They will also name, measure, and classify angles and identify complementary and supplementary angles. Finally, they will use properties and laws of logic to prove basic theorems about congruence, supplementary angles, complementary angles, and vertical angles. Thus unit will focus on the following topics:

- Points, Lines, and Planes
- Measuring and Constructing Segments
- Using Midpoint and Distance Formulas
- Perimeter and Area in the coordinate Plane
- Measuring and Constructing Angles
- Describing Pairs of Angles
- Conditional Statements
- Inductive and Deductive Reasoning
- Postulates and Diagrams
- Algebraic Reasoning
- Proving Statements about Segments and Angles
- Proving Geometric Relationships

- Pairs of Lines and Angles
- Parallel Lines and Transversals
- Proofs with Parallel and Perpendicular Lines
- Equations of Parallel and Perpendicular Lines

Enduring Understandings

- There is an association between the location of two points on a number line and their coordinates.
- The Pythagorean Theorem can be used to determine Right Triangle relationships. The Pythagorean Inequality can be used to classify triangles by their sides.
- The midpoint of a segment is the point that divides the segment into two congruent parts
- Angles are classified as acute, right, obtuse or straight. An angle bisector divides an angle into two congruent angles
- Relationships exist between angles based on their measures. These relationships can be used to determine values for parts of or other associated angles.
- The general form of a linear equation in slope-intercept form is y-mx + b, where m s the slope and b is the y-intercept

Essential Questions

- How do the attributes of geometric figures impact their names and classifications?
- How do you find the distance and the midpoint between two points in the coordinate plane?
- What are angle classifications and how are they used to identify angle relationships?
- What components are used in a geometric proof?

Summative Assessment and/or Summative Criteria

- Section Quizzes
- End of Unit Tests
- End of Quarter Exam

Resources

Desmos https://www.desmos.com/

GeoGebra http://www.geogebra.org/

Cpams http://www.cpalms.org/Public/ToolkitGradeLevelGroup/Toolkit?id=14

Common Core Standards www.corestandards.org

National Council of Teacher of Mathematics www.nctm.org

Khan Academy https://www.khanacademy.org

Achieve the Core http://achievethecore.org

Illustrative Mathematics https://www.illustrativemathematics.org/

Inside Mathematics www.insidemathematics.org

Learn Zillion https://learnzillion.com/resources/75114-math

National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/vlibrary.html

NRICH http://nrich.maths.org

YouCubed https://www.youcubed.org/week-of-inspirational-math/

NCTM Illuminations http://illuminations.nctm.org/Lessons-Activities.aspx (choose grade level and connect to search lessons)

CK-12 www.ck12.org

Mathematics Assessment Project http://map.mathshell.org/tasks.php?collection=9&unit=HE06

Shmoop http://www.shmoop.com/common-core-standards/math.html

Mathematics Common Core Toolbox http://www.ccsstoolbox.org/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmark / Assessments
1-1 Points, Lines, and Planes.	Name points, lines, and planes. Name segments and rays. Sketch intersections of lines and planes. Solve real-	Illustrating geometric models from descriptions. Naming points, lines and planes and using	Check student responses. Check student drawings.

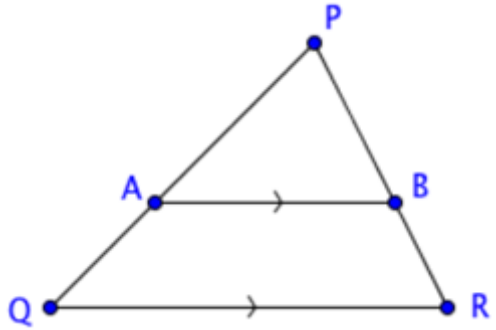
	life problems involving lines and planes. Use point, line, distance along a line and/or distance around a circular arc to give a precise definition of the following: • Angle • circle (the set of points that are the same distance from a single point - the center) • perpendicular line (two lines are perpendicular if an angle formed by the two lines at the point of intersection is a right angle) • parallel lines (distinct lines that have no point in common) • and line segment Identify, name, and represent points, lines, segments, rays, and planes. Apply basic facts, postulates, and theorems about points, lines, and planes.	symbols Colored paper and 3D objects– to show intersecting lines & planes Engage students to investigate more closely the definition of shapes being congruent when they are the same size and shape.	*Quiz: Plane / Points, Lines, Planes
1-2 Measuring and	Use the Ruler Postulate.	Copy segments and compare segments for congruence.	Check computations and

Constructing Segments.	Students from middle school should be familiar with congruent segments (and angles). Segment Addition Postulate.	Use the Segment Addition Postulate. Use actual maps or electronic maps to demonstrate the Segment Addition Postulate. Three cities lie approximately in a straight line. This does not mean vehicular travel would be a straight line, but weather fronts could be. Use actual maps or electronic maps to demonstrate the Segment Addition Postulate.	graphs. Check the accuracy of student responses.
1-3 Using Midpoint and Distance Formulas.	Find segment lengths using midpoints and segment bisectors. Use the Midpoint Formula. Use the Distance Formula.	You want to find the midpoint of something that cannot be folded, like the diagonal of a picture frame. You have a straightedge (not a ruler) and paper. Explain how to find the midpoint. Solving an equation with variables on both sides should be a secure skill for students.	Check computations and graphs. Check the accuracy of student responses.
1-4 Perimeter and Area in the Coordinate Plane.	Classify polygons. Find perimeters and areas of polygons in the coordinate plane. To find the perimeter of a polygon in the coordinate plane, you need to find the length of each side. To find the area of a polygon, it is necessary to deconstruct the polygon into polygons, of	Note that concave polygons are defined as *not* being convex. Students should be familiar with concave lenses and spoons.	To quickly check for understanding, ask students to sketch a convex hexagon, concave octagon, and concave triangle (not possible). Use *Popsicle Sticks* to select students to share their work on the board.

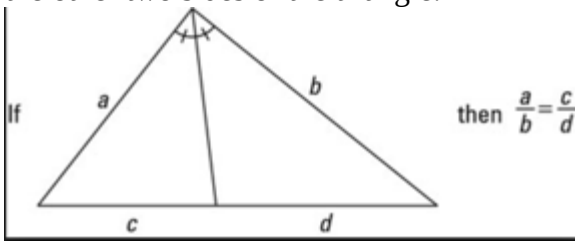
	which you know how to find the area.		
1-5 Measuring and Constructing Angles.	Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles. Name angles. Measure and classify angles. Identify congruent angles. Use the Angle Addition Postulate to find angle measures. Bisect angles.	Show an aerial view of the runways at an airport. Number the angles formed by different run ways to facilitate students being able to reference them more easily. Ask students to make a list of pairs of angles and then state the relationships between each pair of angles. Do not specify the measures of the angles.	Check for comprehension of vocabulary terms. What item is used to measure angles? What are the 7 types of angles? What is the symbol for angle?
1-6 Describing Pairs of Angles.	Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles. Identify complementary and supplementary angles. Identify linear pairs and vertical angles. Write the *Core Concept* and draw sketches to support the definitions. • Note that *complementary* and *supplementary* angles do not need to be adjacent. Their relationship is a matter of measurement, not position.	Model the thinking and processes necessary to understand pairs of angles. Provide students with hands on opportunities to explore and extend their understanding by using available tools such as calculators, graph paper, dry erase markers.	Check for comprehension of vocabulary terms & properties. *Quiz: (Midpoints - Angles & Relationships) *Test

2-1 Conditional Statements.	When is a conditional statement true or false? What is an example of a conditional statement? What is the most common conditional statement? What is IF AND THEN statement?	Pre-teach vocabulary using visual and verbal models that are connected to real life situations. Provide students with hands on opportunities to explore and extend their understanding of conditional statements by using truth table. Link concepts to everyday examples so that students can visualize the truth table and understand the concept of conditional statements. Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.	Write conditional statements. Use definitions written as conditional statements. Write biconditional statements. Make truth tables. Write the *Core Concept*, paying attention to the words and the symbols. Ask students what a double negative is and to give examples. They should also state what the double negative means when simplified. *Example:* "I am not going to not eat" means "I am going to eat."
2-2 Inductive and Deductive Reasoning.	Use inductive reasoning. Use deductive reasoning. Discuss the *Core Concept*. Showing that a conjecture is true means you must show that it is true for all cases. Showing that a conjecture is false means you only need one counterexample. The first law, *Law of Detachment,* is easier to state	Identify the hypothesis and conclusion of statements. Write conditional statements and respective converse, inverse and contrapositive forms. Use basic postulates to determine valid statements. Create & interpret Venn Diagrams.	Call on students to use properties and make statements. Check student diagrams. *Quiz: (Inductive Reasoning, Conditionals,Venn)

	than to understand for most students. Symbolically, it says if $p \rightarrow q$ is true and p is true, then you conclude that q is true. The *Law of Syllogism* says if $p \rightarrow q$ is true and $q \rightarrow r$ is true, then you conclude that $p \rightarrow r$ is true		
2-3 Postulates and Diagrams.	Use postulates involving points, lines, and planes	Identify postulates illustrated by a diagram Analyze a diagram to determine what you can assume Identify postulates using diagrams. Sketch and interpret diagrams. Construct and explain proofs of theorems about triangles including: o a line parallel to one side of a triangle divides the other two sides proportionally; o and the Pythagorean Theorem (using triangle similarity). Use the similarity criteria to establish a new and important relationship found in similar triangles, such as the side splitting theorem and the angle bisector theorem. Side Splitting Theorem: A line parallel to one side of a triangle divides the other two proportionally.	Activity: have students construct diagrams and trade papers, listing assumptions and common misassumptions

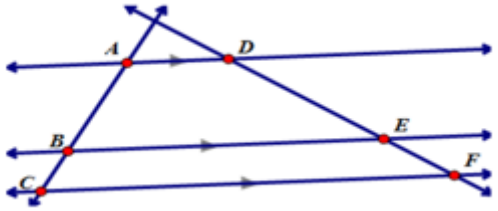


Angle Bisector Theorem: An angle bisector of an angle of a triangle divides the opposite side in two segments that are proportional to the other two sides of the triangle.

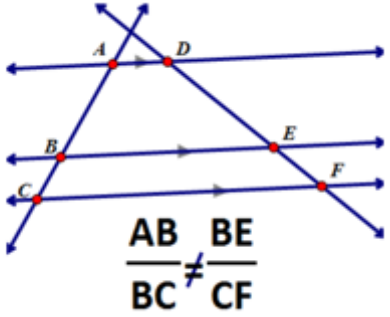


Use student prior connection to similarity with connections to ratios, scale factors, and proportion all connect to the concept of similarity and the non-isometric transformation, dilation.

Prove the Pythagorean Theorem using similarity and the geometric means.



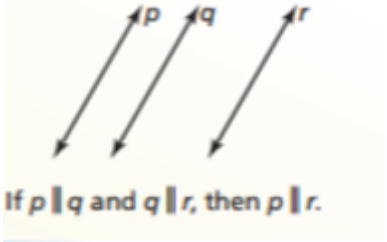
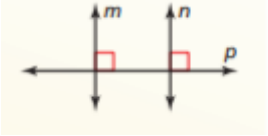
A common error is comparing the proportional pieces cut by the parallel line to the third side

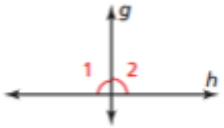
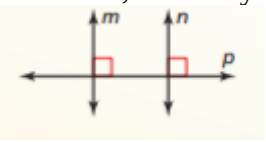
		that has not been cut into pieces. Students too often relate pieces of sides to whole sides and that causes an error.  	
2-4 Algebraic Reasoning.	Justify statements using properties of equality. Use Algebraic Properties of Equality to justify the steps in solving an equation. Use the Distributive Property to justify the steps in solving an equation. Use properties of equality involving segment lengths and angle measures. Discuss the properties in the *Core Concept*. The one property that may be unfamiliar is the Substitution Property of Equality. This property was used when solving systems of equations in algebra.	Justify the steps of a proof with properties of equality Set up and write a two column proof. Name the property of equality involved in a statement. Matching game with name of properties.	Checking for understanding

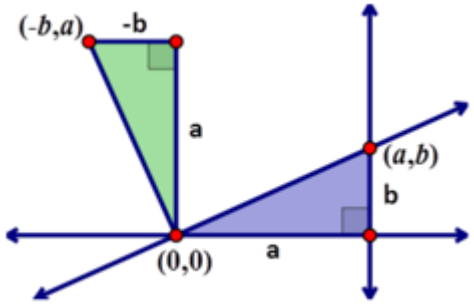
	Apply algebraic properties in geometric proofs.		
2-5 Proving Statements about Segments and Angles.	Organize and complete proofs involving segment theorems.	Write two-column proofs. Name and prove properties of congruence. Begin with a discussion of *proof* and a reminder of deductive reasoning. Explain that statements are either given information or result from applying a known property or fact to statements already made. Reasons are the explanations for the corresponding statements.	Activity: have students complete proofs in rows
2-6 Proving Geometric Relationships.	How can you use a flowchart to prove a mathematical statement? What is the purpose and structure of a proof in geometry? What are the two methods for writing geometric proofs?	Write flowchart proofs to prove geometric relationships. Write paragraph proofs to prove geometric relationships. A flowchart proof is a graphical representation of a two-column proof. Sets of statements and reasons are recorded in boxes, and arrows are drawn from one step to the next. A flowchart proof shows the logical flow of information and how different ideas are combined to formulate the proof. Some students are able to follow the reasoning in a proof more easily when it is presented in a flowchart proof format than when written linearly in a two-column format. Some students find it more evident in a flowchart proof of how particular steps fit together or how one statement is a result of the previous statement(s). However, there are other alternatives as well.	Activity: have students complete proofs in rows

3-1 Pairs of Lines and Angles.	What does it mean when two lines are parallel, intersecting, coincident, or skew? Why are vertical lines a special case for parallel lines? Why is there a special case for a vertical line and a horizontal line being perpendicular?	Identify lines and planes. Identify parallel and perpendicular lines. Identify pairs of angles formed by transversals. Consider taking time for students to practice sketching parallel planes. Explain that three letters are used to identify a plane. Please don't forget to review the slope-intercept form of the equation of a line, $y = mx + b$, where m is the slope of the line and b is the y-intercept. Remind students that the slope of the line is represented by m and describes the steepness of the line. The y-intercept is represented by b, and it is the y-coordinate of the point where the line intersects the y-axis. Students will be working with parallel and perpendicular lines in this chapter, extending what they already know about these concepts in the Cartesian plane.	Check accuracy of student responses. Call on students to restate key properties
3-2 Parallel Lines and Transversals.	When a transversal cuts two parallel lines, Which of the resulting pairs of angles are congruent? Will there always be four acute and four obtuse angles when the Transversal intersects the two parallel lines?	Use properties of parallel lines. Prove theorems about parallel lines. Solve real-life problems. Students will recognize that when parallel lines are given, angle pairs will be supplementary or congruent. Still, expect justification for how the problem is set up. In Example 2, the angles are supplementary because a vertical angle is substituted for a consecutive interior angle. Any previously stated postulate, theorem, or	Pre-teach vocabulary using visual and verbal models that are connected to real life situations. Provide students with hands on opportunities to explore and extend their understanding of parallel lines and

		definition may be used to prove the Alternate Interior Angles Theorem (Thm. 3.2). • Whiteboarding: Have partners work on the proof together. Ask for volunteers to share their work. Continue to ask, "How do you know?	transversals by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc. Encourage students to add this concept to their reference notebook by providing notes or guiding note taking. Link concepts to everyday examples so students can visualize the transformations and internalize their distinguishing characteristics.
3-3 Proofs with Parallel Lines.	Use the Corresponding Angles Converse. Construct parallel lines. Prove theorems about parallel lines. Use the Transitive Property of Parallel Lines. The converse of the Corresponding Angles Theorem (Thm. 3.1) from the previous lesson is also a theorem, the Corresponding Angles Converse (Thm. 3.5). The converses of the other	Pre-teach vocabulary using visual and verbal models that are connected to real life situations. Provide students with hands on opportunities to explore and extend their understanding of parallel lines by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc. Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.	Check accuracy of student responses.

	angle theorems are also theorems and are proven to be true using the Corresponding Angles Converse. **Transitive Property of Parallel lines:** If two lines are parallel to the same line, then they are parallel to each other.  **Lines Perpendicular to a Transversal Theorem:**  		
3-4 Proofs with Perpendicular Lines.	Find the distance from a point to a line. Construct perpendicular lines. Prove theorems about perpendicular lines. Solve real-life problems involving perpendicular lines.	The three theorems need to be read carefully. To introduce the first one ask, "When two lines intersect to form congruent adjacent angles, what do you know?" The lines are perpendicular. Probing Question: "In the Perpendicular Transversal Theorem (Thm. 3.11), why is it necessary for the lines to be coplanar?" If the perpendicular line were not in the same plane as the parallel lines, then it would be	Check accuracy of student responses.

		perpendicular to only one of the parallel lines. • The third theorem demonstrates why there is no transitive property for perpendicular lines! Ask students to identify, aloud or on a paper to be collected, the most significant point (or part) in the lesson that aided their learning. **Linear Pair of Perpendicular Theorem:** If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular.  **Lines Perpendicular to a Transversal Theorem:** In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.  	
3-5 Equations of Parallel and Perpendicular Lines.	Write equations of parallel and perpendicular lines. Use slope to find the distance from a point to a line.	The lesson begins with partitioning a directed line segment into two segments of a specified ratio. The outcome is an ordered pair on the line segment. Solve problems using the slope criteria for parallel and perpendicular lines and determine whether two slopes represent parallel or perpendicular relationships. Find the equation of a line parallel and line perpendicular to a given line that passes through a given point.	Check accuracy of student responses. Chapter Test

		Students should also be able to graph and write linear equations and the slope of a line. specifically.  Knowing that parallel lines that have equal slopes and perpendicular lines have negative reciprocal slopes allows us to further analyze geometric shapes to determine what they are and what properties they have. Classify geometric shapes using slopes and/ or distances. The ability to understand and recognize negative reciprocal is difficult to students. So many students use negative slopes or reciprocal slopes as perpendicular slopes instead or negative reciprocal slopes. The new part of this skill is using two slope relationships to establish or classify various geometric shapes using slope and distance. Students feel comfortable on the grid counting things out but when we use variables for coordinates instead of values they start to struggle.	
17 topics			

Standards

MATH.9-12.G.CO.A.1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
MATH.9-12.G.CO.C.9	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
MATH.9-12.G.CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
MATH.9-12.G.CO.C.11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
MATH.9-12.G.CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
MATH.9-12.G.GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
MATH.9-12.G.GPE.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
MATH.9-12.G.GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

MATH.9-12.G.MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
MATH.9-12.G.SRT.B.4	Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.

Suggested Modifications for Special Education, ELL and Gifted Students

- Pre-teach vocabulary using visual and verbal models that are connected to real life situations.
- Provide students with hands on opportunities to explore and extend their understanding of measuring and constructing segments by using transparencies, graph paper, dry erase markers, cut out shapes.
- Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.
- Encourage students to add this concept to their reference notebook by providing notes or guiding notetaking.

Suggested Technological Innovations/Use

Students leverage existing and emerging technologies to enhance workplace productivity and problem-solving. They demonstrate adaptability in acquiring new technologies and proficiency in utilizing common applications. Recognizing the potential personal and organizational risks associated with technology use, they actively implement measures to prevent or mitigate them.

Career Readiness, Life Literacies and Key Skills Practices Example:

Students will be introduced to the Big Ideas Math instructional program, the intervention platform, and digital platforms such as Google Classroom, Meet, and Jamboard. They will develop critical thinking skills to select appropriate tools, like Graphing Calculators and Geogebra, to explore and deepen their understanding of transformations, congruence, and triangle relationships.

Cross Curricular/Career Readiness, Life Literacies and Key Skills Practice

Model interdisciplinary thinking to expose students to other disciplines.

Art Connection:
Name of Task: Paper Cutting (1.5.12prof.Cr1b)
● This task uses lines of symmetry to demonstrate how they can be used in the art of paper cutting.
ELA Connection:
Name of Tasks: Defining Parallel lines (RL.10.4)
● This task asks students to analyze definitions: Are they mathematically sound, complete, accurate, confusing? This challenges students to
look at the concepts more closely and understand how important definitions are.
Architecture and Construction Career Connection:
Name of Task: Horizontal Stretch of the Plane (9.3.ST-ET.5 and 9.3.ST-SM-2)
● This task asks students to look at the effect of horizontal stretch on an image.

Unit 2: Congruence, Transformations & Relationships within Triangles

Content Area: **Mathematics**
Course(s):
Time Period: **2nd Marking Period**
Length: **38 days**
Status: **Published**

Summary of the Unit

This unit focuses on the topics of properties and congruence, especially as it applies to triangles. Students classify triangles and apply relationships among the angles and sides of a triangle or triangles, including the Triangle Inequality Theorem. Students write congruence statements for triangles and develop an understanding of congruence through transformations. They then continue to develop their understanding of proof, using key postulate and theorems to prove that triangles are congruent. Students use corresponding parts of congruent triangles to write proofs, including flow proofs. They also perform congruence transformations on figures, including translations, reflections, and rotations.

Enduring Understandings

- The sum of the measures of the interior angles of a triangle is 180 degrees
- Triangles can be congruent by the SSS, SAS, AAS, and ASA or HL Theorems
- If triangles are congruent, their corresponding parts are congruent
- A translation is a transformation that moves every point of a figure the same distance in the same direction
- A reflection is a transformation that uses a line of reflection to create a mirror image to the original figure
- A rotation is a transformation in which a figure is turned about a point

Essential Questions

- How can you find the measure of the third angle of a triangle if you know the measure of the other

two angles?

- How can you use congruent triangles to prove angles or sides congruent?
- How do you identify a rigid motion in the plane?
- What transformations create an image congruent to the original figure?

Summative Assessment and/or Summative Criteria

- Section Quizzes
- End of Unit Tests
- End of Quarter Exam

Resources

Desmos https://www.desmos.com/

GeoGebra http://www.geogebra.org/

Cpams http://www.cpalms.org/Public/ToolkitGradeLevelGroup/Toolkit?id=14

Common Core Standards www.corestandards.org

National Council of Teacher of Mathematics www.nctm.org

Khan Academy https://www.khanacademy.org

Achieve the Core http://achievethecore.org

Illustrative Mathematics https://www.illustrativemathematics.org/

Inside Mathematics www.insidemathematics.org

Learn Zillion https://learnzillion.com/resources/75114-math

National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/vlibrary.html

NRICH http://nrich.maths.org

YouCubed https://www.youcubed.org/week-of-inspirational-math/

NCTM Illuminations http://illuminations.nctm.org/Lessons-Activities.aspx (choose grade level and connect to search lessons)

CK-12 www.ck12.org

Mathematics Assessment Project http://map.mathshell.org/tasks.php?collection=9&unit=HE06

Shmoop http://www.shmoop.com/common-core-standards/math.html

Mathematics Common Core Toolbox http://www.ccsstoolbox.org/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmark / Assessments
4-1 Translations	Given a geometric	Perform translations and compositions.	Assess students on

	figure and its rotation, reflection, or translation, identify the components of the two figures that are congruent. Students will be able to answer the following questions How can you translate a figure in a coordinate plane? What are the 4 types of transformations? What are the 5 transformations? How do you write a translation in geometry? What are the 3 types of rigid transformations?	Solve real-life problems involving compositions. The definition of a rigid motion (isometry) is simple to state and says a lot! Remind students that a transformation moves points in the plane, and when the length and angle measure are preserved, it is called a *rigid motion*.	translating a given figure over a given line.
4-2 Reflections	**Students will be able to understand:** How can you reflect a figure in a coordinate plane? "Is a glide reflection a rigid motion? Explain	Perform reflections. Perform glide reflections. Identify lines of symmetry. Solve real-life problems involving reflections. Draw two points on scrap paper. Crease the paper to form the *line of reflection* for the points. Draw the segment that connects the	Assess students on reflecting a given figure over a given line. Model the thinking and processes necessary to determine a series of transformations that end up with the figure

	How do you write a reflection in geometry? What is a real-world example of a reflection? What's a reflection in geometry? What are the four types of geometric transformations?	two points. Use this model to highlight the property of the line of reflection being the perpendicular bisector of the segment joining the two points.	superimposing on top of itself.
4-3 Rotations	**Students will be able to understand** How can you rotate a figure in a coordinate plane? What do you need to know if you want to perform a rotation? Is it necessary to find the image of all three vertices to rotate a triangle? Explain. How do you write a rotation in geometry? What is a real-life example of rotation?	Perform rotations and compositions with rotations. Identify rotational symmetry. Use a transparency at the overhead or document camera, or use an electronic model that allows the *center of rotation* to be visible as the rotation is occurring.	Homework assigned. Classwork assigned. Common core. Asses students on finding the equation of an image of a line rotated at 90 °, 180° or 270 °about the origin.

	What are the four types of geometric transformations?		
4-4 Congruence and Transformations	Students will be able to: Identify congruent figures. Describe congruence transformations. Use theorems about congruence transformations.	Define *congruent figures* in terms of a rigid motion. Note the "if and only if" language of the definition. Have students *Turn and Talk* to answer the *Monitoring Progress* question. What evidence are partners offering? They should be stating a rigid motion that mapped one figure to another. Use the definition of congruence as a test to see if two figures are congruent. Recall two geometric figures are congruent if and only if a rigid motion or a composition of rigid motions maps one of the figures onto the other. A rigid motion maps each part of a figure to a corresponding part of its image. Because rigid motions preserve length and angle measure, corresponding parts of congruent figures are congruent. In congruent polygons, this means that the corresponding sides and the corresponding angles are congruent	Assess students on performing the combinations of two or more transformations.
4-5 Dilations	**Students will be able**	Perform dilations to verify the impact of	Assess students' ability to

	to Identify and perform dilations. Solve real-life problems involving scale factors and dilations. What does it mean to dilate a figure? How do you do dilations in geometry? How do you find the scale factor of dilation? What two things are required for dilation? What's dilation in geometry?	dilations on lines and line segments. Perform dilations and examine properties affecting sides from a pre-image to an image (scale factor affects side length) Create dilations that verify that corresponding sides from a preimage to an image are parallel and length is affected by the scale factor.	find the image of a given figure after a dilation with its center at a given point and/or at the origin with a given scale factor.
4-6 Similarity and Transformations	**Students will be able to** Perform and describe similarity transformations. Prove that figures are similar. When a figure is translated, reflected, rotated, or dilated in the plane, is the image always similar to the original figure?	Students focus on a pair of corresponding sides. What dilation about the origin will make them the same size? Does the orientation need to change (reflection)? Does the location need to change (translation)? Does the position need to change (rotation)? Students focus on a pair of corresponding sides. What dilation about the origin will make them the same size? Does the orientation need to change (reflection)? Does the location need to change (translation)? Does the position need to change (rotation)?	

	How can you prove that two squares are similar? What is an example of a similarity transformation? What are the 3 types of transformations? Which sequence of transformations is considered to be similarity transformations? What are the 5 transformations?		
5-1 Angles of Triangles	Discover and apply the Triangle Sum Theorem. Discover and apply the Exterior Angle Theorem. Classify triangles and find the measures of their angles	Discovery: exterior angle = sum of remote angles Apply the angle sum theorem to find angle measures. Use the exterior angle theorem to determine angle measures.	Call on students to use properties and make statements. Check student diagrams
5-2 Congruent Polygons	Use the definition of congruence as a test to	How do you determine if two figures are congruent?	Call on students to use properties and make statements.

	see if two figures are congruent. Recall two geometric figures are congruent if and only if a rigid motion or a composition of rigid motions maps one of the figures onto the other. A rigid motion maps each part of a figure to a corresponding part of its image. Because rigid motions preserve length and angle measure, corresponding parts of congruent figures are congruent. In congruent polygons, this means that the corresponding sides and the corresponding angles are congruent	What conjectures can you make about a figure reflected in two lines? What does it mean for two figures to be congruent? What will the transformation of a figure look like given descriptions of rigid motions?	Check student diagrams
5-3 Proving Triangle Congruence by SAS	Discover, compare & apply the SAS and HL theorems to test for triangle congruence. Identify & explain the	Identify and use various postulates & theorems to complete proofs. Group proofs where students are given all statements and reasons as puzzle pieces and must put proof together.	Check for comprehension. Check the accuracy of student responses. Drag and drop proofs on Chromebook

	appropriate theorem to use to prove congruence between two triangles.		
5-4 Equilateral and Isosceles Triangles	Discover and apply the Isosceles Triangle theorems. **Discover and apply the Equilateral triangle theorems.**	Identify the parts of an isosceles triangle Find the values of angles for isosceles triangles using leg/bases angle theorems. **Use isosceles triangle theorems in proofs.**	Call on students to use properties and make statements. Check student diagrams. ***Quiz: (Proving triangles congruent, Isosceles)**
5-5 Proving Triangle Congruence by SSS	Discover, describe, and apply the SSS Postulate	Activity: Drawing experiments in which students draw a triangle with the first two pieces matching on patty paper, then complete their triangle on their own, and finally match their triangle with their classmates.	Call on students to use properties and make statements. Check student diagrams. Introduce Flow Chart Proofs Drag and drop proofs on Chromebook
5-6 Proving Triangle Congruence by ASA and AAS	Discover, describe, and apply the ASA and AAS postulates when testing or proving triangle congruence.	Activity: Discover the AAS theorem by copying two angles & a non-included side of a triangle, then reconstruct parts to create a congruent triangle	Call on students to use properties and make statements . Check student diagrams. Discuss why SSA and AAA are not Postulates
5-7 Using Congruent Triangles	Use congruent triangles to prove corresponding parts of congruent triangles are congruent	Have students use GeoBoards to create 2 parallel lines cut by a transversal. Students can use a protractor to measure each angle and make conjectures about the	Check student diagrams. Drag and drop proofs on Chromebook

		relationships	
5-8 Coordinate Proofs	How do you write a coordinate proof?	Place figures in a coordinate plane. Write coordinate proofs. Use coordinates to prove geometric theorems including: • Prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle (or other quadrilateral). • Prove or disprove that a given point lies on a circle of a given center and radius or point on the circle. Students may use geometric simulation software to model figures and prove simple geometric theorems.	Check student proofs
Perpendicular and Angle Bisectors 6-1	Identify and apply properties of perpendicular bisectors to solve problems	Students will construct perpendicular bisectors based on a set of instructions.	Check for comprehension. Have students correct an incorrect problem
Bisectors of Triangles 6-2	Identify and apply properties of angle bisectors to find distance relationships	Students will construct angle bisectors based on a set of instructions. They will then conclude the properties of Angle Bisectors	Check for comprehension.

	Identify the point of Concurrency of Angle Bisectors		Calculate the point of concurrency using the coordinate plane.
Medians and Altitudes of Triangles 6-3	Identify and apply properties of medians and altitudes of triangles Identify the point of Concurrency of Medians and Altitudes	Students will construct angle bisectors based on a set of instructions. They will then draw conclusions about properties of Medians and Altitudes	Check for comprehension. Discuss which of the Special segments can be inside vs. outside of the triangle. Use colored cards for "inside" and "outside" and have students hold them up as each segment is said aloud. Have students draw special segments with different colors.
17 topics			

Standards

MATH.9-12.G.C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
MATH.9-12.G.CO.A.2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

MATH.9-12.G.CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
MATH.9-12.G.CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
MATH.9-12.G.CO.A.5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
MATH.9-12.G.CO.B.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
MATH.9-12.G.CO.B.7	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
MATH.9-12.G.CO.B.8	Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
MATH.9-12.G.CO.C.9	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
MATH.9-12.G.CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
MATH.9-12.G.CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
MATH.9-12.G.CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
MATH.9-12.G.GMD.A.2	Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
MATH.9-12.G.GPE.B.4	Use coordinates to prove simple geometric theorems algebraically.
MATH.9-12.G.MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g.,

	modeling a tree trunk or a human torso as a cylinder).
MATH.9-12.G.MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MATH.9-12.G.SRT.A.1.a	A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
MATH.9-12.G.SRT.A.1.b	The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
MATH.9-12.G.SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Suggested Modifications for Special Education, ELL and Gifted Students

Consistent with individual plans, when appropriate.

- Students will be allowed to submit assignments using additional time per IEP modifications.
- Students will be encouraged to use different size and type of font in order to avoid print confusion.
- ML students will be allowed to use an internet translator or language glossary in order to translate vocabulary and assignments properly.
- ML students may be allowed to work with another student who is fluent in their native language.

Suggested Technological Innovations/Use

Students leverage existing and emerging technologies to enhance workplace productivity and problem-solving. They demonstrate adaptability in acquiring new technologies and proficiency in utilizing common applications. Recognizing the potential personal and organizational risks associated with technology use, they actively implement measures to prevent or mitigate these risks.

Career Readiness, Life Literacies and Key Skills Practices Example:

Students will be introduced to the Big Ideas Math instructional program, the intervention platform, and digital platforms such as Google Classroom, Meet, and Jamboard. They will develop critical thinking skills to select appropriate tools, like Graphing Calculators and Geogebra, to explore and deepen their understanding of

transformations, congruence, and triangle relationships.

Cross Curricular/Career Readiness, Life Literacies and Key Skills Practice

Credit and Debt Management (9.1.12.CDM.8)
Compare and compute interest and compound interest and develop an amortization table using business tools.
Example: Students will use their growing understanding of exponentials functions to compare interest rates and make informed decisions about the merits
and pitfalls of different types of debt.
• Career Awareness and Planning (9.2.12.CAP.10)
Identify strategies for reducing overall costs of postsecondary education (e.g. tuition assistance, loans, grants, scholarships, and student loans.
Example: Students will compare the immediate and long term costs and benefits of different options available to pay for college and career education after
high school. Students can develop a suggested plan for hypothetical students based on their qualifications and financial circumstances.
• Technology Literacy (9.4.12.TL.1)
Assess digital tools based on features of accessibility options, capacities, and utility for accomplishing a specified task.
Example: Students can use and explain the advantages of using graphing calculators, GeoGebra or Desmos to visualize transformations,
congruence, and relationships within triangles to solve contextual problems. The discussion should also involve developing ways to improve and
develop even better algorithms. https://www.desmos.com/calculator
https://www.geogebra.org/geometry?lang=en-US

Physical Education Connection:
Backyard Basketball (2.12.MSC.2)
● This task uses similar triangles to calculate the height of a basketball net.
Engineering and Technology Connection:

Two Wheels And a Belt (9.3.ST.ET.4)
● This task combines two skills from domain G-C: making use of the relationship between a tangent segment to a circle and the radius
touching that tangent segment (G-C.2), and computing lengths of circular arcs given the radii and central angles (G-C.5). It also requires
students to create additional structure within the given problem, producing and solving a right triangle to compute the required central
angles (G-SRT.8).
Theodolite (9.3.ST.ET.4)
● This task has students explore indirect measurement.

Link https://www.nj.gov/education/cccs/2020/2020%20NJSLS-CLKS.pdf

Unit 3: Relationships within Triangles, Quadrilaterals and Other Polygons.

Content Area: **Mathematics**
Course(s):
Time Period: **3rd Marking Period**
Length: **43 days**
Status: **Published**

Summary of the Unit

In this unit, students will find angle measures in polygons. They will investigate the properties of parallelograms and learn what information they can use to conclude that a quadrilateral is a parallelogram. Students will also study special quadrilaterals such as rhombuses, rectangles, squares, trapezoids, and kites. Students will also use proportions to identify similar polygons and find the scale factor between two polygons, they use a scale factor to find corresponding lengths in similar polygons, and they use the AA Similarity Postulate, the SSS Similarity Theorem, or the SAS Similarity Theorem to determine whether two triangles are similar. Also, students use proportions and the Triangle Proportionality Theorem or its converse to find the lengths of segments related to the triangles or parallel lines. Finally, students perform dilations that are reductions or enlargements and they verify that a figure is similar to its dilation.

Enduring Understandings

- Investigate the properties of special quadrilaterals
- Classify quadrilaterals based on the characteristics of their sides, angles, and diagonals
- Recognize that all squares are similar
- If two polygons are similar, the ratio of any two corresponding lengths equals the scale factor
- A dilation is a transformation that preserves angle measures and results in an image with lengths proportional to the preimage lengths
- You can prove triangles are similar by the AA, SSS, and SAS Similarity Theorems
- A line parallel to one side of a triangle intersecting the other side divides those sides proportionally, and vice versa
- Three parallel lines intersecting two transversals divide the transversals proportionally

Essential Questions

- If two figures are similar, how do you find the length of a missing side?

- How can you show that two triangles are similar?
- How do you identify a similarity transformation to the plane?
- How do you dilate a figure in the coordinate plane?
- How do you find a missing angle measure in a convex polygon?
- What can you say about the interior and exterior angles of convex polygons?
- How to prove properties of special quadrilaterals and then apply them.

Summative Assessment and/or Summative Criteria

- Section Quizzes
- End of Unit Tests
- End of Quarter Exam

Resources

Desmos https://www.desmos.com/

GeoGebra http://www.geogebra.org/

Cpams http://www.cpalms.org/Public/ToolkitGradeLevelGroup/Toolkit?id=14

Common Core Standards www.corestandards.org

National Council of Teacher of Mathematics www.nctm.org

Khan Academy https://www.khanacademy.org

Achieve the Core http://achievethecore.org

Illustrative Mathematics https://www.illustrativemathematics.org/

Inside Mathematics www.insidemathematics.org

Learn Zillion https://learnzillion.com/resources/75114-math

National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/vlibrary.html

NRICH http://nrich.maths.org

YouCubed https://www.youcubed.org/week-of-inspirational-math/

NCTM Illuminations http://illuminations.nctm.org/Lessons-Activities.aspx (choose grade level and connect to search lessons)

CK-12 www.ck12.org

Mathematics Assessment Project http://map.mathshell.org/tasks.php?collection=9&unit=HE06

Shmoop http://www.shmoop.com/common-core-standards/math.html

Mathematics Common Core Toolbox http://www.ccsstoolbox.org/

Unit Plan

Topic/Selection	General Objectives	Instructional Activities	Benchmark /

Timeframe			**Assessments**
The Triangle Midsegment Theorem **6-4**	Use properties of midsegments and write coordinate proofs.	Students will draw midsegment of triangle and then compare its length and slope to the third side of the triangle Construction: Students will construct	Completion of coordinate proof on board
Indirect Proof and Inequalities in One Triangle **6-5**	Discover & apply the triangle inequality theorem. Use inequalities to make comparisons in two triangles	Discovery Lesson: Spaghetti triangle experiment to physically prove or disprove theorems. Determine if triangles can be made of specific segments. Journal: advice column how to tell if your triangle is a triangle	Use dice simulation to roll 3 dice on SmartBoard. Alternatively, roll 3 dice and write the numbers on the board. Have students hold up red (no) or green (yes) papers to determine whether or not the three measurements can construct a triangle
Inequalities in Two Triangles **6-6**	Describe and apply relationships between sides and angles in a triangle.	Discovery: Draw triangle ABC, use ruler & protractor to make table of side & angle measures to compare. Use inequality theorems to compare sides and angles of triangles. Discovery: Door & Ruler experiment Use the SAS (hinge theorem) & SSS inequality theorems to compare sides and angles of triangles.	Use Kahoot or other online assessment activity to review concepts.

Angles of Polygons 7-1	To find the measures of interior and exterior angles of convex polygons by using formula.	An example of the relationship between interior and exterior angles of a polygon in problem solving will be conducted.	Assess understanding by having students recognize the relationship between regular tessellations and interior/exterior angles of regular polygons.
Properties of Parallelograms 7-2	To apply definition of a parallelogram and the theorems about properties of a parallelogram in problem solving. Calculate the area of parallelograms and rectangles	Students will investigate proving theorems about parallelograms using congruent triangles by writing two column or flow proofs. Demonstrate examples of how to apply properties of parallelograms in problem solving.	Assess understanding by having students prove that the diagonals of a parallelogram bisect each other by using a two-column proof.
Proving That a Quadrilateral Is a Parallelogram **7-3**	To prove that certain quadrilaterals are parallelograms using congruent triangles and or using other known facts.	Students will investigate proving theorems about parallelograms using congruent triangles by writing two column or flow proofs. Demonstrate examples of how to prove a quadrilateral is a parallelogram in problem solving.	Assess students understanding by having them prove that if one pair of opposite sides of a parallelogram is both parallel and congruent then the quadrilateral is a parallelogram by using a two-column and/or flow proof.
Properties of Special Parallelograms **7-4**	To prove theorems about rectangles are parallelograms with congruent diagonals	Students will investigate proving theorems about rectangles are parallelograms with congruent diagonals by using congruent triangle by writing two column or flow	Assess students understanding by having them prove that if the diagonals of a

	using congruent triangles and or other known facts. Calculate the area of squares and rhombi	proofs.	parallelogram are congruent then the parallelogram is a rectangle by using two-column and/or flow-proof.
Properties of Trapezoids and Kites **7-5**	To apply the definition and identify the properties of a trapezoid, an isosceles trapezoid and a kite To calculate the area of trapezoids and kites	Students will investigate the properties of an isosceles trapezoid and kite by using geometer sketchpad, construction or two- column/flow-proofs. Demonstrate an example of how to apply properties of trapezoid, an isosceles trapezoid and kite in problem solving. Construction: Students will use compass/ruler or technology to create a kite	Assess students understanding by having them find the lengths of the bases given the ratio of the lengths of the bases of a trapezoid and the length of midsegment.
Similar Polygons **8-1**	Describe & identify similar polygons. Examine & solve problems involving characteristics of similar figures.	Discovery: Draw polygon/triangle on transparency and measure sides and angles, use overhead projector to display on board and measure to compare findings. Identify scale factors and similar figures. Use scale factors and proportions to solve for unknown side measures of similar polygons.	Call on students to illustrate properties and definitions. Similar figures scavenger hunt
Proving Triangle Similarity by AA 8-2	Describe criteria needed to identify similar triangles. Apply properties of similar triangles to solve problems.	Write and use corresponding similar triangle statements. Use the AA similarity theorem to prove triangles are similar.	Ask students to explain the key concepts.

Proving Triangle Similarity by SSS and SAS 8-3	Describe criteria needed to identify similar triangles. Apply properties of similar triangles to solve problems.	Write and use corresponding similar triangle statements. Use the SSS, & SAS similarity theorems to prove triangles are similar.	Ask students to explain the key concepts.
Proportionality Theorems 8-4	Use proportions with a triangle or parallel lines	Recall: Midsegment Theorem Use coordinate plane Geometry to make conjectures about parallel lines and proportional parts	Call on students to illustrate properties and definitions.
The Pythagorean Theorem 9-1	Discover ways of applying the Pythagorean theorem and its converse. Identify and list Pythagorean triples. Determine if a triangle is acute, right or obtuse.	Use Pythagorean Theorem and its converse to find right triangle segment measures and prove triangles are right. Use and recognize Pythagorean Triples. Use Pythagorean theorem to determine if a triangle is acute, right or obtuse from side lengths.	Check understanding of problem set-up and methods for solving. *Quiz (Pythagorean and Distance Formula)
Special Right Triangles 9-2	Discover and apply the properties of special right triangles. Recognize the links between the square & the 45-45-90 triangle	Look for Pattern – Students in each row use Pythagorean theorem. To solve for missing sides of special right triangles, record answers on board, and find formulas through patterns. Memorize and apply the 45-45-90 special right triangle formula to simplify process of finding unknown side lengths of the right triangles. Solve problems involving squares & equilateral triangles.	Ask students to explain the key concepts. Construction: Students will use protractor and ruler to create and calculate side measures of special right triangles
Similar Right Triangles 9-3	Use properties of the altitude of a right	Find and use the geometric mean between two numbers.	Check understanding of problem set-up and

	triangle Use Geometric Mean to calculate missing sides of right triangles	Use geometric mean to find unknown leg, altitude, and segment measures for right triangles. Prove Pythagorean Theorem Using similar triangles.	methods for solving.
15 topics			

Standards

MATH.9-12.G.CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
MATH.9-12.G.CO.C.11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
MATH.9-12.G.GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
MATH.9-12.G.GPE.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
MATH.9-12.G.MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
MATH.9-12.G.MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MATH.9-12.G.SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity

	for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
MATH.9-12.G.SRT.A.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
MATH.9-12.G.SRT.B.4	Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
MATH.9-12.G.SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
MATH.9-12.G.SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Suggested Modifications for Special Education, ELL and Gifted Students

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Students will be introduced to the Big Ideas Math instructional program, the intervention platform, and digital platforms such as Google Classroom, Meet, and Jamboard. They will develop critical thinking skills to select

appropriate tools, like Graphing Calculators and Geogebra, to explore and deepen their understanding of transformations, congruence, and triangle relationships.

Cross Curricular/Career Readiness, Life Literacies and Key Skills Practice

Model interdisciplinary thinking to expose students to other disciplines.

Geography Connection:
Task Name: Neglecting the Curvature of the Earth (6.2.8.GeoPP.3.a)
● This task takes into consideration the curvature of the earth to find the distance between two locations.
Task name: How Far Is the Horizon (6.2.8.GeoPP.3.a)
● The purpose of this modeling task is to have students use mathematics to answer a question in a real-world context using mathematical
tools that should be very familiar to them. The task gets at particular aspects of the modeling process, namely, it requires them to make
reasonable assumptions and find information that is not provided in the task statement.
Architecture and Construction Career Cluster Connection:
Task name: Access Ramp (9.3.ST-SM-2)
● You have been commissioned to design an access ramp, which complies with the Americans with Disabilities Act (ADA) requirements, for
an entry that is 3 feet above ground level.

Unit 4: Trigonometric Ratios,Circles and Volume.

Content Area: **Mathematics**
Course(s):
Time Period: **4th Marking Period**
Length: **42 days**
Status: **Published**

Summary of the Unit

In this unit students investigate aspects of circles. They start by drawing tangents to the circle and see how a tangent to the circle is related to the radius at the point of tangency. They use intercepted arcs of circles to measure angles formed by chords in a circle They explore relationships between segment lengths of chords that intersect in a circle, and they investigate relationships between segment lengths of secants and tangents to the circle. Finally, they use the standard equation of a circle to graph and describe circles in a coordinate plane.

Enduring Understandings

- All circles are similar.
- The geometric understanding that comes from proving triangles similar may be used to prove relationships between geometric objects.
- Different relationships among inscribed angles, radii, and chords of a circle, and between the angles of a quadrilateral inscribed in a circle are provable using previously proven relationships between geometric objects.
- A circle drawn in the coordinate plane can be represented by an algebraic equation that is dependent upon the coordinates of the center of the circle and the radius of the circle.

Essential Questions

- What are different relationships among inscribed angles, radii, and chords of a circle, and the angles of a quadrilateral inscribed in a triangle, angles formed by two tangents or two secants or a secant and a tangent?
- What is the relationship between segment lengths of chords, secants and tangents to the circle?
- What is the relationship between the length of an arc of a circle, the central angle of the circle that intercepts this arc, and the radius of the circle?
- Given the coordinates of the center of a circle and the radius of the circle, what is the equation of the circle?
- Given an equation for a circle drawn in the coordinate plane, what are the coordinates of center and radius of the circle?

Summative Assessment and/or Summative Criteria

- Section Quizzes
- End of Unit Tests
- End of Quarter Exam

Resources

Desmos https://www.desmos.com/

GeoGebra http://www.geogebra.org/

Cpams http://www.cpalms.org/Public/ToolkitGradeLevelGroup/Toolkit?id=14

Common Core Standards www.corestandards.org

National Council of Teacher of Mathematics www.nctm.org

Khan Academy https://www.khanacademy.org

Achieve the Core http://achievethecore.org

Illustrative Mathematics https://www.illustrativemathematics.org/

Inside Mathematics www.insidemathematics.org

Learn Zillion https://learnzillion.com/resources/75114-math

National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/vlibrary.html

NRICH http://nrich.maths.org

YouCubed https://www.youcubed.org/week-of-inspirational-math/

NCTM Illuminations http://illuminations.nctm.org/Lessons-Activities.aspx (choose grade level and connect to search lessons)

CK-12 www.ck12.org

Mathematics Assessment Project http://map.mathshell.org/tasks.php?collection=9&unit=HE06

Shmoop http://www.shmoop.com/common-core-standards/math.html

Mathematics Common Core Toolbox http://www.ccsstoolbox.org/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmark / Assessments
The Tangent Ratio **9-4**	Find trigonometric ratios using right triangles. Use tangent ratio for indirect measurement	Use trig ratios to find angle measures & side measures of right triangles.	Check understanding of problem set-up and methods for solving.
The Sine and Cosine Ratios **9-5**	Find trigonometric ratios using right triangles. Use Sine and Cosine ratios for indirect measurement Interpret word problems and model figures to determine and use angles of elevation and depression.	Use trig ratios to find angle measures & side measures of right triangles. Enrichment: Angles of Elevation and Depression	Check understanding of problem set-up and methods for solving. Using sine and cosine to calculate the tangent
Solving Right Triangles **9-6**	Use Tangent, Sine and Cosine ratios for indirect measurement Interpret word problems and model figures to	Students can create word problems with scenarios to be sketched and solved by peers	Students will draw a picture for each scenario.

	determine and use angles of elevation and depression.		
Lines and Segments That Intersect Circles **10-1**	To apply theorems that relates tangents and radii.	Introduce definition of a tangent and use geometer sketchpad and/or two column proofs or flow proofs to demonstrate various properties of tangents. Students will investigate how to construct a tangent line from a point outside a given circle to the circle using compass and straightedge.	Check for key vocabulary terms. Assess students by having them construct tangents to a given circle from a point outside the circle.
Circles in the Coordinate Plane **10-7**	To derive the equation of a circle of given center and radius using the Pythagorean theorem; completing the square. To find the center and radius of a circle given by an equation.	Demonstrate how to use the definition of circle and distance formula to derive the equation of circle.	Assess students on their ability to write the equation of a circle in standard form using completing the squares and finding measures of angles in radians. Chapter test
Inscribed Angles and Polygons **10-4**	To construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle using construction, technology or proofs. To solve problems and prove statements involving inscribed angles by using technology or proofs.	Use a geometric sketchpad or construction or two column/flow-proofs to show the relationship between the inscribed angle and the intercepted arc. Extend the lesson to construct inscribed triangles to prove the properties of angles for a quadrilateral. Students will investigate how to construct an inscribed square using a compass and straightedge.	Assess students on writing steps to construct inscribed triangles. Apply the properties of angles of inscribed quadrilaterals to determine the measure of an arc and vice-versa.

6 topics			

Standards

MATH.9-12.G.C.A.2	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
MATH.9-12.G.C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
MATH.9-12.G.C.A.4	Construct a tangent line from a point outside a given circle to the circle.
MATH.9-12.G.CO.A.1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
MATH.9-12.G.CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
MATH.9-12.G.GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
MATH.9-12.G.GPE.B.4	Use coordinates to prove simple geometric theorems algebraically.
MATH.9-12.G.MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MATH.9-12.G.SRT.C.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
MATH.9-12.G.SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
MATH.9-12.G.SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Suggested Modifications for Special Education, ELL and Gifted Students

Consistent with individual plans, when appropriate.

- Students will be allowed to submit assignments using additional time per IEP modifications.
- Students will be encouraged to use different size and type of font in order to avoid print confusion.
- ML students will be allowed to use an internet translator or language glossary in order to translate vocabulary and assignments properly.
- ML students may be allowed to work with another student who is fluent in their native language.

Suggested Technological Innovations/Use

Students leverage existing and emerging technologies to enhance workplace productivity and problem-solving. They demonstrate adaptability in acquiring new technologies and proficiency in utilizing common applications. Recognizing the potential personal and organizational risks associated with technology use, they actively implement measures to prevent or mitigate these risks.

Career Readiness, Life Literacies and Key Skills Practices Example:

Students will be introduced to the Big Ideas Math instructional program, the intervention platform, and digital platforms such as Google Classroom, Meet, and Jamboard. They will develop critical thinking skills to select appropriate tools, like Graphing Calculators and Geogebra, to explore and deepen their understanding of transformations, congruence, and triangle relationships.

Cross Curricular/Career Readiness, Life Literacies and Key Skills Practice

Social Studies Connection
The Great Egyptian Pyramids (6.2.8.HistoryCC.2.a)
● This task uses the Great Pyramids as a source to calculate the volume, height, and length of a real-world object.
Science Connection
How many cells are in the Human Body? (HS-LS1-1)
● The purpose of this task is for students to apply the concepts of mass, volume, and density in a real-world context.

Physical Education Connection:

Tennis Balls in a Can: A Real-World Volume Problem

This activity explores the concept of volume using a familiar object – a can of tennis balls.